NASA TECHNICAL MEMORANDUM NASA TM X-73919

NASA TM X-73919

CONCORDE NOISE-INDUCED BUILDING VIBRATIONS FOR SULLY PLANTATION CHANTILLY, VIRGINIA

By

Staff-Langley Research Center

June 1976

This informal documentation medium is used to provide accelerated or special release of technical information to selected users. The contents may not meet NASA formal editing and publication standards, may be revised, or may be incorporated in another publication.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA 23665

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM X-73919		

4. Title and Subtitle	5. Report Date
Concorde Noise-Induced Building Vibrations for Sully Plantation, Chantilly, Virginia	June 1976
	6. Performing Organization Code: 2630
7. Author(s): Staff-Langley Research Center*	8. Performing Organization Report No.
	10. Work Unit No.: 504-09-13-01
9. Performing Organization Name and Address: NASA-Langley Research Center, Hampton, VA 23665	11. Contract or Grant No.
	13. Type of Report and Period Covered: Technical Memorandum
12. Sponsoring Agency Name and Address: National Aeronautics and Space Administration, Washington, DC 20546	14. Sponsoring Agency Code

15. Supplementary Notes

*Acoustics and Noise Reduction Division
W. H. Mayes, H. F. Scholl,
D. G. Stephens, B. G. Holliday

*Instrument Research Division
R. DeLoach, H. K. Holmes,
R. B. Lewis, J. W. Lynch

16. Abstract

This is the first report on a series of planned studies to assess the noise-induced building vibrations associated with Concorde operations. The approach is to record the levels of induced vibrations and associated indoor/outdoor noise levels in selected homes, historic and other buildings near Dulles and Kennedy International Airports. Presented herein is a small, representative sample of data recorded at Sully Plantation, Chantilly, Virginia during the period of May 20 through May 28, 1976. Recorded data provide relationships between the vibration levels of walls, floors, windows and the noise associated with Concorde operations (2 landings and 3 takeoffs), other aircraft, nonaircraft sources, and normal household activities. Results suggest that building vibrations resulting from aircraft operations were proportional to the overall sound pressure levels and relatively insensitive to spectral differences associated with the different types of aircraft. Furthermore, the maximum levels of vibratory response resulting from Concorde operations were higher than those associated with conventional aircraft. The vibrations of nonaircraft events were observed in some cases to exceed the levels resulting from aircraft operations. These nonaircraft events are currently being analyzed in greater detail.

17. Key Words (Suggested by Author(s)) (STAR category underlined)	18. Distribution Statement
Noise, building vibrations, structural response to noise 71	Unclassified Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	41	$3.75

*Available from { The National Technical Information Service, Springfield, Virginia 22151
STIF/NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, MD 20740

CONCORDE NOISE-INDUCED BUILDING VIBRATIONS FOR SULLY PLANTATION CHANTILLY, VIRGINIA

By Staff-Langley Research Center*

SUMMARY

This is the first report on a series of planned studies to assess the noise-induced building vibrations associated with Concorde operations. The approach is to record the levels of induced vibrations and associated indoor/outdoor noise levels in selected homes, historic and other buildings near Dulles and Kennedy International Airports. Presented herein is a small, representative sample of data recorded at Sully Plantation, Chantilly, Virginia during the period of May 20 through May 28, 1976. Recorded data provide relationships between the vibration levels of walls, floors, windows, and the noise associated with Concorde operations (2 landings and 3 takeoffs), other aircraft, nonaircraft sources, and normal household activities. Results suggest that building vibrations resulting from aircraft operations were proportional to the overall sound pressure levels and relatively insensitive to spectral differences associated with the different types of aircraft. Furthermore, the maximum levels of vibratory response resulting from Concorde operations were higher than those associated with conventional aircraft. The vibrations of nonaircraft events were observed in some cases to exceed the levels resulting from aircraft operations. These nonaircraft events are currently being analyzed in greater detail.

*Acoustics and Noise Reduction Division
W. H. Mayes, H. F. Scholl,
D. G. Stephens, B. G. Holliday

Instrument Research Division
R. DeLoach, H. K. Holmes,
R. B. Lewis, J. W. Lynch

INTRODUCTION

The vibratory response of historic and other buildings resulting from Concorde operations and the associated effects in terms of structural damage and human annoyance have been the subject of public concern (ref. 1). As a result of this concern, measurements of Concorde noise-induced building vibrations (ref. 2) are being conducted as part of the total Concorde assessment program. The first study in this phase of the assessment was carried out at Sully Plantation during the time period of May 20 through May 28, 1976.

The approach to the assessment of Concorde noise-induced building vibrations involves the following steps: (1) the measurement of the vibratory response of windows, floors, and walls for selected historic (e.g., Sully Plantation), and other buildings; (2) the development of functional relationships ("signatures") between the vibration response of building elements and the range of outdoor and/or indoor noise levels associated with events of interest; (3) a comparison of the Concorde induced response with the response associated with other aircraft as well as common domestic events and/or criteria. The development of vibration/noise relationships or signatures (step 2) allows one to determine the response of the structure under study or a similar structure to any (similar) noise level of interest. This procedure reduces the reliance on maximum response levels and the associated statistical difficulty resulting from small sample sizes. Also the precise location of the noise source (the maximum level) is not essential to this approach.

This interim report includes a brief overview of the tests conducted at Sully Plantation including data acquisition and reduction schemes, a log of the recorded events, and results obtained during initial Concorde operations.

Results are presented in terms of the vibration/noise signatures and comparative levels of vibration associated with Concorde, other aircraft and nonaircraft events.

TEST SITE DESCRIPTION

Location

Figure 1 shows the location of Sully Plantation adjacent to Sully Road (Virginia State Route 23) 1.2 kilometers north of U.S. Route 50 in Chantilly, Virginia. The Plantation is 6.4 kilometers south of the Dulles Airport access road and approximately 2.2 kilometers south-southeast from the end of Dulles Airport Runway 1R.

Structural Details

Figure 2 is a photograph of the south elevation of Sully Plantation. As described in reference 3, the building is a two and one-half story central section flanked by asymmetrical one and one-half story gabled wings. Its foundation of red sandstone, averaging almost 2 feet in thickness, support walls which are sheathed by clapboards that cover a heavy mortise-and-tenon framing. The walls of the earliest portion of the house are insulated by means of the common 18th century "nogging" (filled with brick). Figure 3 shows a section of wall which has been cut away to reveal the nogging. The nogging is covered with lath (figure 4) and three layers of plaster. Random width pine flooring attached directly to floor joists is used throughout the house (no subfloor). Windows are generally the 12 over 12 sashing type with some being of 9 over 9, 6 over 9, and 6 over 6. Of the 324 window panes at Sully, half are original and a typical pane measures 20.3 cm by 25.4 cm and varies from 0.16 cm to

0.32 cm in thickness. All of the panes have been covered with transparent plastic Scotch-tint film to aid in reflecting sunlight.

The first floor of Sully contains three major rooms in addition to the main entrance hallway. Upstairs are two spacious bedrooms, a large chamber, and a small lodging room.

Figure 5 shows a plan view of the first floor of Sully Plantation including test instrumentation locations. The instrumentation systems were located in the parlor and south end of the drawing room and consisted of three accelerometers and one microphone for each room. Installation of the instruments is shown in figures 6 through 8. A microphone was also located adjacent to each room, outside of the building. Radio communication was established between the test rooms and data acquisition vans.

DATA LOG

All data measurements taken at the Sully Plantation test site were recorded during the period May 20 through May 28, 1976. Table I is a chronological listing of events during this time period. A total of 93 events were measured which included not only aircraft operations and room calibrations but typical house occurrences such as visiting tour groups, radio playing, chair falling, etc.

DATA ACQUISITION AND PROCEDURE

Instrumentation

Two mobile instrument systems were employed, one completely analog operated under contract by Wyle Laboratory personnel supporting measurements in the south room and a second, containing both an analog capability as well as an online digital processing system, supporting the north room. Figure 9 shows both vehicles as they were deployed at Sully Plantation and figures 10 and 11 are block diagrams of the respective instrument systems. The analog data acquisition equipment in both vehicles was virtually identical. Acoustic measurements of both inside and outside sound pressure levels were made using conventional Bruel and Kjaer measuring equipment. Vibration data were obtained from piezoelectric crystal accelerometers mounted on the floor, wall, and window of each room and processed with in-house developed signal conditioning electronics. All data were recorded on analog FM tape so that subsequent spectral analysis or specialized weighting functions could be applied to the data as the need or interest dictates. Online analog x-y plots of window vibration response versus outside sound pressure level were obtained in each vehicle; a typical plot for the Air France takeoff may be found in figure 12. In the larger vehicle, a General Radio 1926 (multichannel, true rms) log voltmeter was employed to sample, analog-to-digital convert, average, and log convert each of the five signals into overall readings (each 1/2 second) for subsequent digital processing. A Hewlett-Packard 21M20 digital computer was then used to format these data into line prints of the time history values and to provide "Calcomp" plots of the acoustic time histories of both inside and outside overall sound pressure levels as well as plots of selected

acceleration levels as a function of outside sound pressure levels. A typical readout, again for the Air France takeoff, is shown in figures 13 and 14.

Frequency Response and Calibration Procedures

In addition to extensive pretest documentation regarding frequency response, deviation linearities, gain accuracies and dynamic range, daily calibrations consisted of: tape recorder sensitivity (deviation) checks, pink noise (exhibiting flat 1/3-octave band spectrum) insertion in the microphone channels, one-half volt sine wave reference voltage insertion into accelerometer channels, and 250 Hz piston phone acoustic calibration of the microphone systems for pretest and posttest as a minimum and more frequently, time permitting. Frequency response of the acoustic channels is nominally $\pm$ 1 dB over the range from approximately 5 Hz to 10 kHz and $\pm$ 1/2 dB over the range from approximately 3 Hz to in excess of 3 kHz for the accelerometer channels.

Test Procedures and Communications

Visual observation of airport activity via an opening in the roof of the house, monitoring tower communications with aircraft in the area, and/or spotters located some distance from the plantation were used to identify aircraft operations as well as to control and coordinate data acquisition. Hand-held transceivers operating on 171.150 MHz were used for local communications between all elements. Time code synchronized with WWVH was recorded in both vehicles to provide a common time reference for later analysis. Because 5 to 10 minutes were required for a complete data dump from the computer, those events which were not obtained in real time with the computer were readily obtained from tape playback.

Reference Acoustic Source

To provide a controlled acoustic input into each of the rooms, an Altec Model 9844A, playback/monitor speaker system having a frequency response extending from approximately 50 Hz to 15 kHz was used as the transducer. The speaker system contains two 12 inch (30.48 cm) speakers and a high-frequency horn. USASI shaped noise spectra at several acoustic levels (as monitored on a hand-held sound level meter) were impressed on the wall from approximately 6 feet (1.83 meters) away and data recordings made. Some sine wave testing was also performed. Figure 15 shows this system in the parlor (north room) essentially as it was positioned for the calibration tests.

RESULTS AND DISCUSSION

Before presenting the results of this study, a comment on the observed "hysteresis loop" (figure 12, for example) is in order. This unexpected result is believed to be due to diffraction effects as a result of building, microphone, and flight path geometry as illustrated in the plan view sketch of figure 16. The top sketch shows schematically the flight path relative to the Sully Plantation building and instrument locations. The flight path can be broken down into three regions as indicated to provide the acoustic loading patterns designated as regions I, II, and III. It can be seen that when the aircraft is in region II, the microphone A and accelerometer are loaded differently and that the response indicated in the bottom sketch would be expected. This hypothesis was confirmed by conducting some special tests using an additional microphone (shown as microphone B in sketch of figure 16) near the Sully north wall. The response signature as illustrated in the figure was obtained with the microphone A location whereas a straight line relationship

was obtained for microphone B location. Based on this information, only the data from the top line of the response signatures (region I) and referenced to microphone A position are presented in this report. It should be noted that microphone A was located in the free field to enable direct comparisons with other noise measurements or noise data bases.

Sample vibratory response data and associated outdoor noise levels are presented in graphical form (figs. 17 through 22) to provide the functional relationships or "signatures" between vibratory response and aircraft noise. Also, the maximum vibration levels recorded are presented in tabular form (tables 2 through 4) to enable comparisons between Concorde and other aircraft and nonaircraft noise sources.

Review of all measurements indicate that the maximum vibratory response occurred on the window located in the north wall. The window response was greater for takeoff operations than landing operations. Consequently, the vibratory response signatures presented in this report are limited to the response of the north window for takeoff operations. Figure 17 represents data for three Concorde takeoff operations from different runways (Runway 19L, 19R, and 1L, respectively). The data are observed to cluster about a single line (least squares fit) and indeed show a linear relationship between response and noise level. This linear relationship is particularly significant in that it not only gives the absolute response of the aircraft as recorded but enables extrapolation to other runway cases, flyover distances, or other house locations assuming the availability of a noise data base. Also, the linear relationship and relatively small scatter band indicates that detailed spectral information may not be required which greatly simplifies the data gathering process.

Inspections of the plots from the other aircraft takeoff operations shown in figures 18 through 22 indicate similar linear relationships and, in fact, it is noted that approximately the same slopes are obtained for all the aircraft. This result suggests that the window response is dependent upon pressure amplitude but may be independent of spectral content for the aircraft tested. Thus, the hypothesis (ref. 4) that Concorde induced building response will be greater due to the low frequency content of the Concorde spectrum may be questionable.

Maximum values of acceleration recorded for approach and takeoff aircraft operations as well as nonaircraft operations are presented in tables 2 through 4 for the north room which as noted previously had the greatest exposure and response. The events included on these tables were selected to give a representative sample of the events recorded and were in general the events having relatively high response levels. The maximum levels of vibratory response (windows, walls, floors) resulting from aircraft operations were associated with the Concorde for this series of tests. The vibrations of nonaircraft events were observed in some cases to exceed the levels resulting from aircraft operations. These nonaircraft events are currently being analyzed in greater detail.

CONCLUDING REMARKS

Building vibratory response data were recorded at Sully Plantation, Chantilly, Virginia during the period of May 20 through May 28, 1976, as part of the Concorde assessment program. Relationships between the vibration levels of walls, floors, and windows and the noise associated with Concorde operations, other aircraft, and nonaircraft events were obtained from the data. Maximum vibratory response was recorded on a north window which faces the Dulles

runways and was recorded during aircraft takeoff operations. A linear relationship was found to exist between the window response and the overall sound pressure levels for all the aircraft. Furthermore, the level of vibratory response for a given noise level appears to be independent of the type of aircraft which suggests that the response is dominated by the overall sound pressure level and possibly independent of spectral differences among aircraft. The maximum levels of vibratory response (windows, walls, floors) resulting from aircraft operations were associated with the Concorde for this series of tests. The vibrations of nonaircraft events were observed in some cases to exceed the levels resulting from aircraft operations. These nonaircraft events are currently being analyzed in greater detail.

REFERENCES

1. Concorde Supersonic Transport Aircraft Final Environmental Impact Statement, Volume 1. U.S. Department of Transportation, Federal Aviation Administration, September 1975.

2. Structures Directorate-NASA Langley Research Center: The Assessment of Concorde Noise-Induced Building Vibrations - A Study Plan, Mar. 8, 1976.

3. Gamble, Robert S.: Sully - The Biography of a House. Sully Foundation Limited, Chantilly, Virginia, 1973.

4. Department of Transportation, United States of America: The Secretary's Decision on Concorde Supersonic Transport. Washington, DC, Feb. 4, 1976.

TABLE I.- OPERATIONS LOG

EVENT NO.	DATE	TIME		RUNWAY	AIRCRAFT TYPE	AIRCRAFT OPERATION	BUILDING OPERATION		REMARKS
		A.M.	P.M.				DRAWING ROOM	PARLOR	
101	5-20-76		4:55	IR	DC-8	Landing	-	-	
102	5-21-76	8:45		-	-	-	90 dB Cal.		USASI Noise
103	5-21-76	8:50		-	-	-	80 dB Cal.		USASI Noise
104	5-21-76	8:55		-	-	-	70 dB Cal.		USASI Noise
105	5-21-76	9:00		-	-	-	Ambient Cal.		
106	5-21-76	9:40		-	-	-	90 dB Cal.		USASI Noise
107	5-21-76	10:10		-	-	-	80 dB Cal.		USASI Noise
108	5-21-76	10:20		-	-	-	Ambient Cal.		
109	5-21-76	11:00		IR	DC-8	Landing	-	-	
110	5-21-76	11:34		IR	727	Landing	-	-	
111	5-21-76	11:36		19L	727	Takeoff	-	-	
112	5-21-76	11:37		19L	707	Takeoff	-	-	
113	5-21-76	11:44		19L	DC-8	Takeoff	-	-	
114	5-21-76	11:52		-	Helicopter	Overhead	-	-	
115	5-21-76		12:06	19L	727	Takeoff	-	-	
116	5-21-76		1:08	19L	DC-9	Takeoff	-	-	
117	5-21-76		3:13	IR	DC-9	Landing	-	-	
118	5-22-76	-	-	IR	Gen. Av. Jet	Landing	-	-	
119	5-22-76	10:23		IR	727	Landing	-	-	
120	5-22-76	10:25		IR	R-5 Navy	Landing	-	-	

TABLE I.- CONTINUED

EVENT No.	DATE	TIME		RUNWAY	AIRCRAFT TYPE	AIRCRAFT OPERATION	BUILDING OPERATION		REMARKS
		A.M.	P.M.				DRAWING ROOM	PARLOR	
121	5-22-76	10:50		IR	707	Landing	-	-	
122	5-22-76	10:58		IR	727	Landing	-	-	
123	5-22-76	11:10		IR	DC-8	Landing	-	-	
124	5-22-76	11:50		IR	DC-9	Landing	-	-	
125	5-22-76		12:20	IR	727	Landing	-	-	
126	5-24-76	9:12		IR	747	Landing	-	-	
127	5-24-76	9:25		IR	747	Landing	-	-	
128	5-24-76	9:59		IR	747	Landing	-	-	
129	5-24-76	10:50		IR	727	Landing	-	-	
130	5-24-76	10:56		IR	707	Landing	-	-	
131	5-24-76	11:10		IR	727	Landing	-	-	
132	5-24-76	11:50		IR	Concorde	Landing	-	-	
133	5-24-76	11:53		IR	Concorde	Landing	-	-	
134	5-25-76	9:04		IR	707	Landing	-	-	
135	5-25-76	9:16		IR	727	Landing	-	-	
136	5-25-76	-	-	IR	707	Touch and Go	-	-	
137	5-25-76	10:16		IR	707	Touch and Go	-	-	
138	5-25-76	10:19		IR	727	Landing	-	-	
139	5-25-76	10:38		IR	707	Touch and Go	-	-	
140	5-25-76	10:50		IR	727	Landing	-	-	

TABLE I.- CONTINUED

EVENT No.	DATE	TIME A.M.	TIME P.M.	RUNWAY	AIRCRAFT TYPE	AIRCRAFT OPERATION	BUILDING OPERATION DRAWING ROOM	BUILDING OPERATION PARLOR	REMARKS
141	5-25-76		12:05	19L	Concorde	Takeoff	-	-	
142	5-25-76		12:59	19R	Concorde	Takeoff	-	-	
143	5-25-76		3:10	19L	727	Takeoff	-	-	
144	5-25-76		3:33	19L	BAC-111	Takeoff	-	-	
145	5-25-76		3:45	19L	BAC-111	Takeoff	-	-	
146	5-25-76		3:55	19L	BAC-111	Takeoff	-	-	
147	5-26-76	8:56		19L	727	Takeoff	-	-	
148	5-26-76	9:13		19L	707	Takeoff	-	-	
149	5-26-76	9:23		19L	DC-8	Takeoff	-	-	
150	5-26-76	9:30		19L	707	Takeoff	-	-	
151	5-26-76	9:48		19L	727	Takeoff	-	-	
152	5-26-76	10:03		19L	727	Takeoff	-	-	
153	5-26-76	10:13		19L	747	Takeoff	-	-	
154	5-26-76	11:09		19L	BAC-111 or DC-9	Takeoff	-	-	
155	5-26-76	11:11		19L	727	Takeoff	-	-	
156	5-26-76		1:25	-	-		Tour Group 20-30 People		Adults
157	5-26-76		1:29	-	-	-	Tour Group 20-30 People		Adults
158	5-26-76		1:32	-	-	-		Tour Group 4-6 People	Adults
159	5-26-76		1:40	-	-	-	-	Door Slams	
160	5-26-76		1:42	-	-	-	-	Door Slams	

TABLE I.- CONTINUED

EVENT No.	DATE	TIME		RUNWAY	AIRCRAFT TYPE	AIRCRAFT OPERATION	BUILDING OPERATION		REMARKS
		A.M.	P.M.				DRAWING ROOM	PARLOR	
161	5-26-76		1:43	-	-	-	Chair Falling	-	
162	5-26-76		1:55	-	-	-	Chair Falling	-	
163	5-26-76		2:04	-	-	-	Radio Playing	-	
164	5-26-76		2:07	-	-	-		Radio Playing	
165	5-26-76		2:18	-	-	-	Ambient Cal.	Ambient Cal.	
166	5-26-76		2:23	-	-	-	-	Vacuum Cleaner	
167	5-27-76	9:38		-	-	-	-	85 dB Cal.	USASI Noise
168	5-27-76	9:47		-	-	-	-	90 dB Cal.	USASI Noise
169	5-27-76	9:57		-	-	-	-	95 dB Cal.	USASI Noise
170	5-27-76	10:06		-	-	-	-	100 dB Cal.	USASI Noise
171	5-27-76	10:11		-	-	-	-	20-100 Hz Cal.	Sine Wave
172	5-27-76	10:15		-	-	-	-	100-1 kHz Cal.	Sine Wave
173	5-27-76	10:21		-	-	-	-	100-200 Hz Cal.	Sine Wave
174	5-27-76	10:32		-	-	-	Tour Group 20-30 People	-	Children
175	5-27-76	10:45		-	-	-	-	Tour Group 4-6 People	Children

TABLE I.- CONCLUDED

EVENT No.	DATE	TIME		RUNWAY	AIRCRAFT TYPE	AIRCRAFT OPERATION	BUILDING OPERATION		REMARKS
		A.M.	P.M.				DRAWING ROOM	PARLOR	
176	5-27-76			1L	Concorde	Takeoff	-	-	
177	5-27-76		1:31	1R	747	Landing	-	-	
178	5-27-76		3:20	-	-	-	85 dB Cal.	-	USASI Noise
179	5-27-76		3:22	-	-	-	90 dB Cal.		USASI Noise
180	5-27-76		3:24	-	-	-	95 dB Cal.	-	USASI Noise
181	5-27-76		3:28	-	-	-	100 dB Cal.	-	USASI Noise
182	5-27-76		3:30	-	-	-	20-100 Hz Cal.	-	Sine Wave
183	5-27-76		3:33	-	-	-	100-1 kHz Cal.	-	Sine Wave
184	5-27-76		4:01	-	-	-	-	-	Cement Truck on RT 28
185	5-27-76		4:05	-	-	-	-	-	Cement Truck on RT 28
186	5-27-76		4:06	-	-	-	-	-	Panel Truck on RT 28
187	5-27-76		4:08	-	-	-	-	-	Panel Truck on RT 28
188	5-27-76		4:11	-	-	-	-	-	Tank Truck on RT 28
189	5-27-76		4:13	-	-	-	-	-	Two semitrucks on RT 28
190	5-28-76		-	19L	707	Takeoff	-	-	
191	5-28-76		-	19L	C-130	Takeoff	-	-	
192	5-28-76		-	19L	747	Takeoff	-	-	
193	5-28-76		-	19L	707	Takeoff	-	-	

TABLE II.- MAXIMUM VALUES OF AIRCRAFT LANDING

VIBRATION RESPONSE DATA

Aircraft	Event	Overall SPL, dB* Ext.	Int.	Overall Acceleration, g_{rms} Wall	Floor	Window
DC-8	101	76.0	65.4	.023	.019	.039
DC-8	109	83.3	65.4	.022	.021	.038
DC-8	123	82.9	67.7	.010	.014	.016
727	110	78.2	65.2	.021	.020	.040
727	119	75.2	68.3	.011	.011	.010
727	129	79.9	66.4	.015	.013	.025
727	131	76.2	63.4	.015	.013	.017
727	140	75.5	64.1	.008	.008	.015
DC-9	117	79.3	63.8	.011	.008	.018
DC-9	124	75.7	63.9	.012	.011	.017
Private Jet	118	82.2	67.0	.013	.010	.021
707	121	72.7	71.7	.013	.015	.017
707	130	77.8	65.3	.015	.013	.015
707	139	68.8	63.3	.008	.009	.010
747	128	81.3	64.4	.013	.012	.020
BA Concorde	132	91.5	75.5	.016	.016	.065
AF Concorde	133	87.1	71.8	.013	.012	.067

* SPL values correspond to max vibration level and do not necessarily represent max recorded SPL values.

TABLE III.- MAXIMUM VALUES OF AIRCRAFT TAKEOFF

VIBRATION RESPONSE DATA

Aircraft	Event	Overall SPL, dB*		Overall Accelerations, g_{rms}		
		Ext.	Int.	Wall	Floor	Window
707	112	95.0	75.2	.014	.021	.044
707	149	100.2	73.7	.028	.021	.160
DC-8	113	95.2	75.3	.013	.017	.090
727	152	82.2	66.5	.019	.018	.041
727	151	90.3	70.6	.019	.017	.078
727	115	86.2	68.1	.025	.023	.120
DC-9	116	86.1	67.4	.013	.013	.037
AF Concorde	141	106.1	84.2	.048	.024	.432
BA Concorde	142	81.1	65.3	.010	.008	.019
AF Concorde	176	85.3	70.6	.012	.014	.039
BAC-111	145	107.5		.027	.016	.245
BAC-111	146	85.9	67.6	.010	.009	.040
747	153	88.8	69.7	.022	.020	.051
747	192	92.0		.013	.014	.091
Private Jet	194	84.5		.011	.013	.034

* SPL values correspond to max vibration level and do not necessarily represent max recorded SPL values.

TABLE IV.- MAXIMUM VALUES OF VIBRATION RESPONSE

DATA DUE TO SPECIAL EVENTS

Activity	Event	OA SPL, dB* Ext.	OA SPL, dB* Int.	OA Acceleration, g_{rms} Wall	OA Acceleration, g_{rms} Floor	OA Acceleration, g_{rms} Window
Tour Group	175	NA	73.3	.013	.068	.013
Vacuum Cleaner	166	NA	96.3	.025	.065	.105
USASI Noise	167	NA	85.0	.015	.018	.025
USASI Noise	168	NA	91.0	.016	.023	.042
USASI Noise	169	NA	96.0	.020	.036	.084
USASI Noise	170	NA	102.0	.029	.064	.143

* SPL values correspond to max vibration level and do not necessarily represent max recorded SPL values.

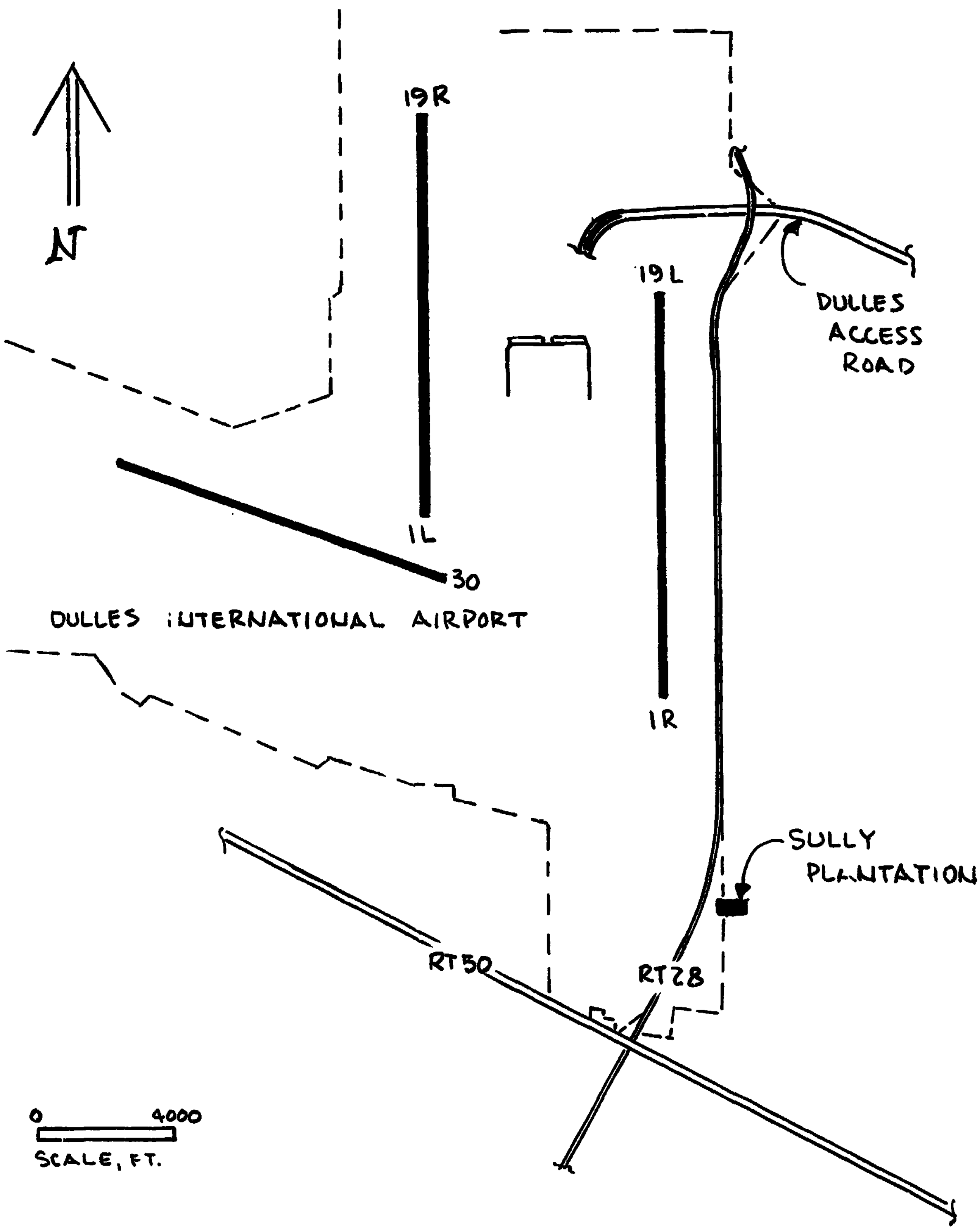

Figure 1.- Location of Sully Plantation

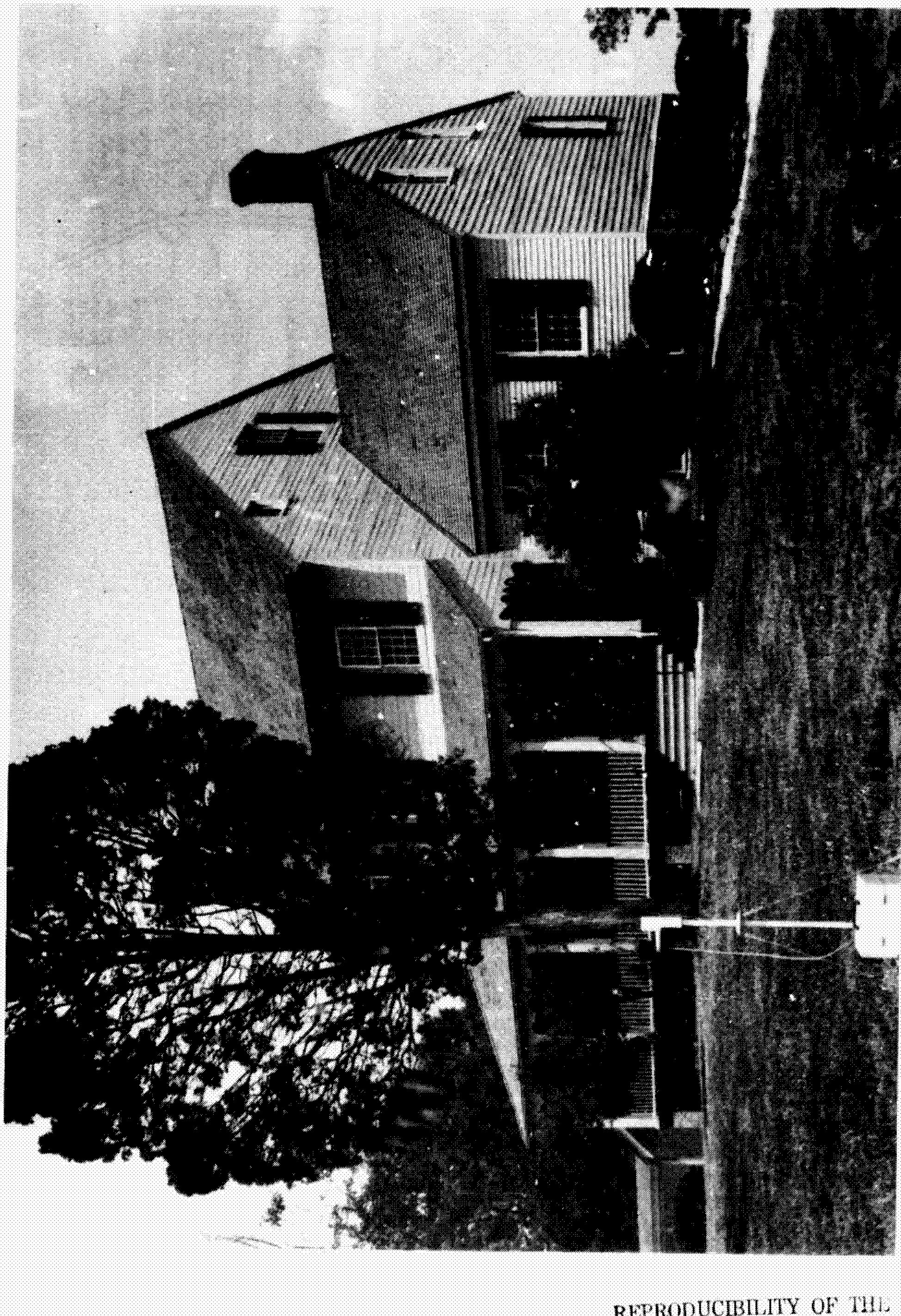

Figure 2.- South elevation of Sully Plantation.

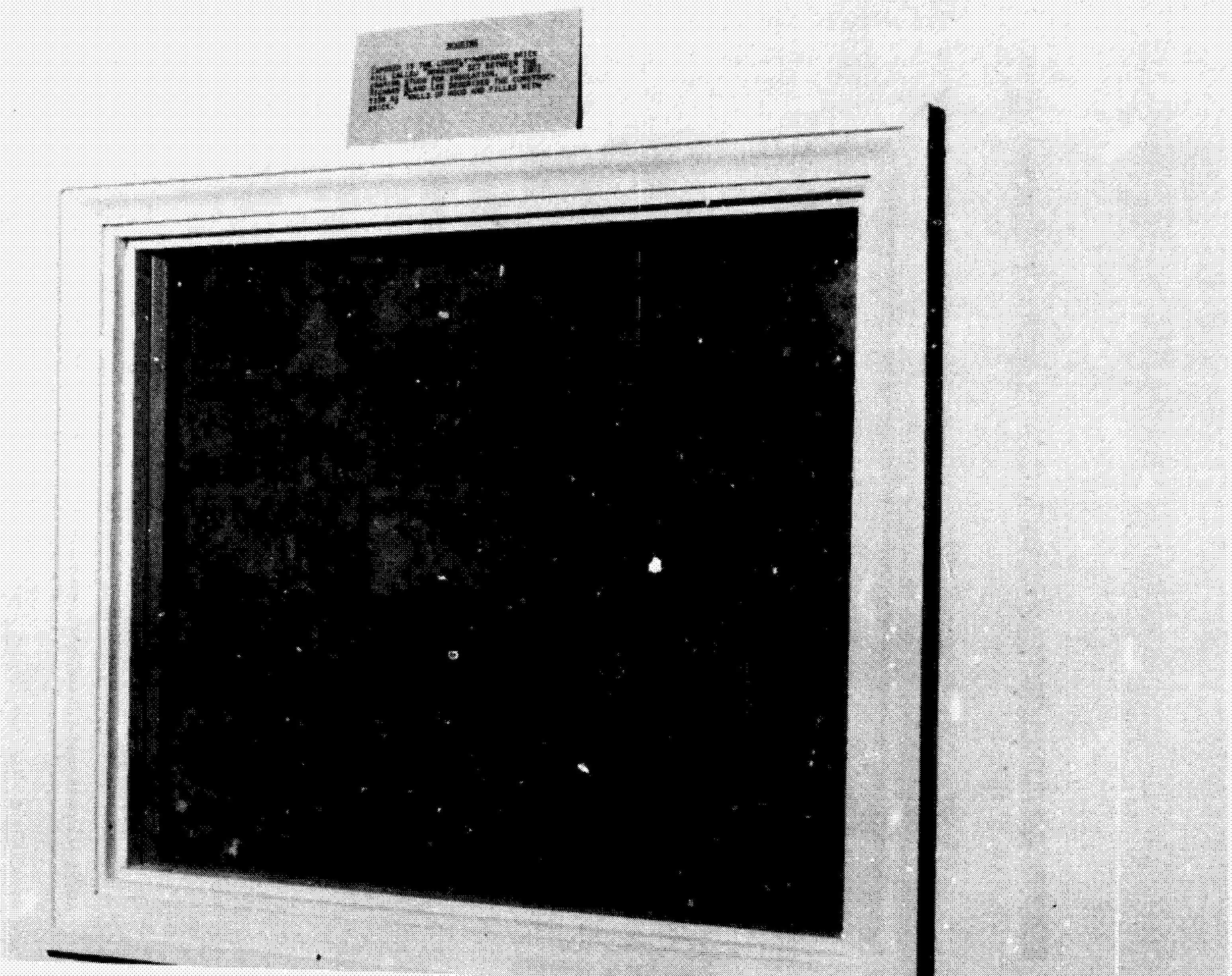

Figure 3.- Cutaway wall section showing "nogging" construction.

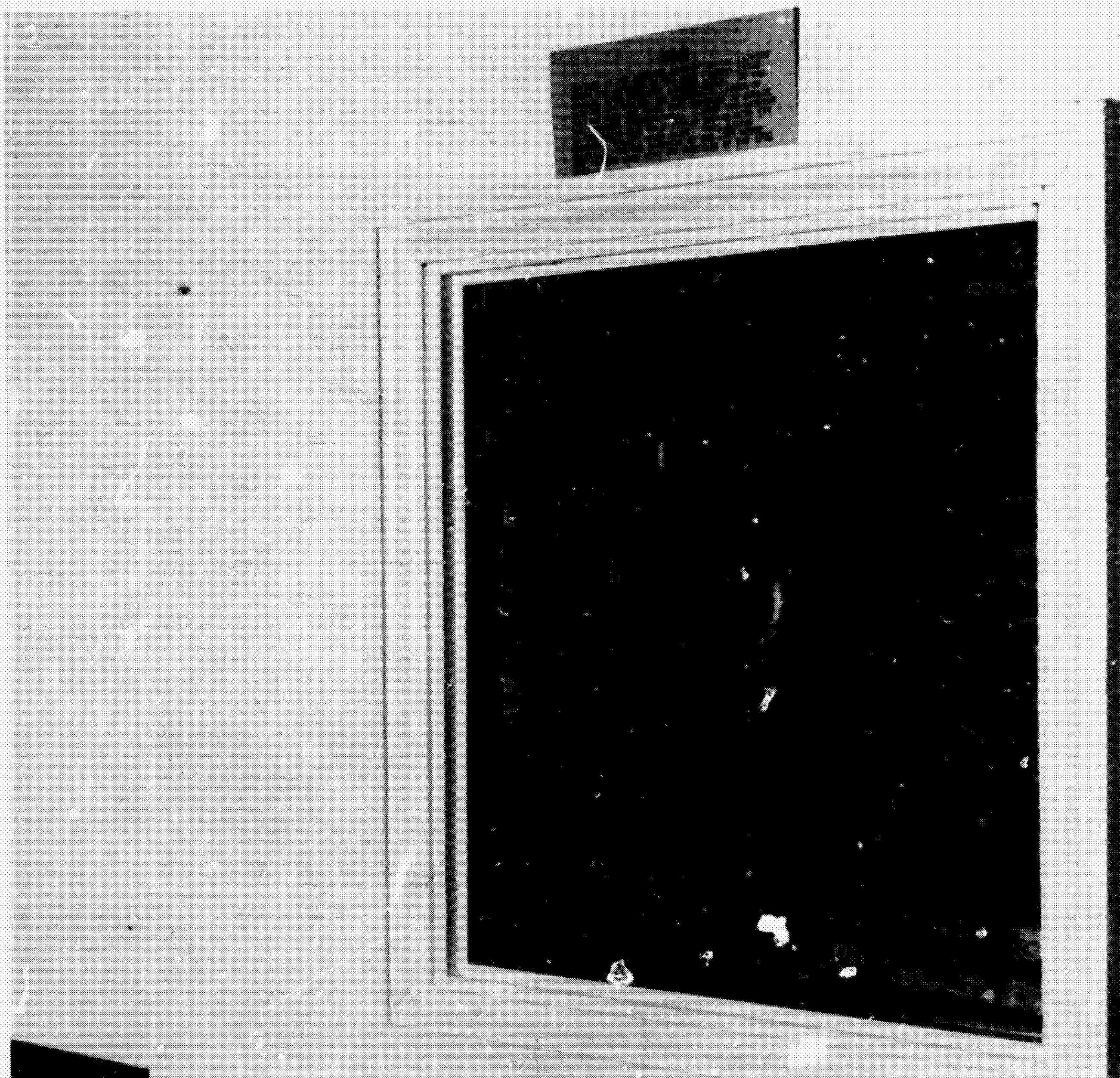

Figure 4.- Cutaway wall section showing plaster lath.

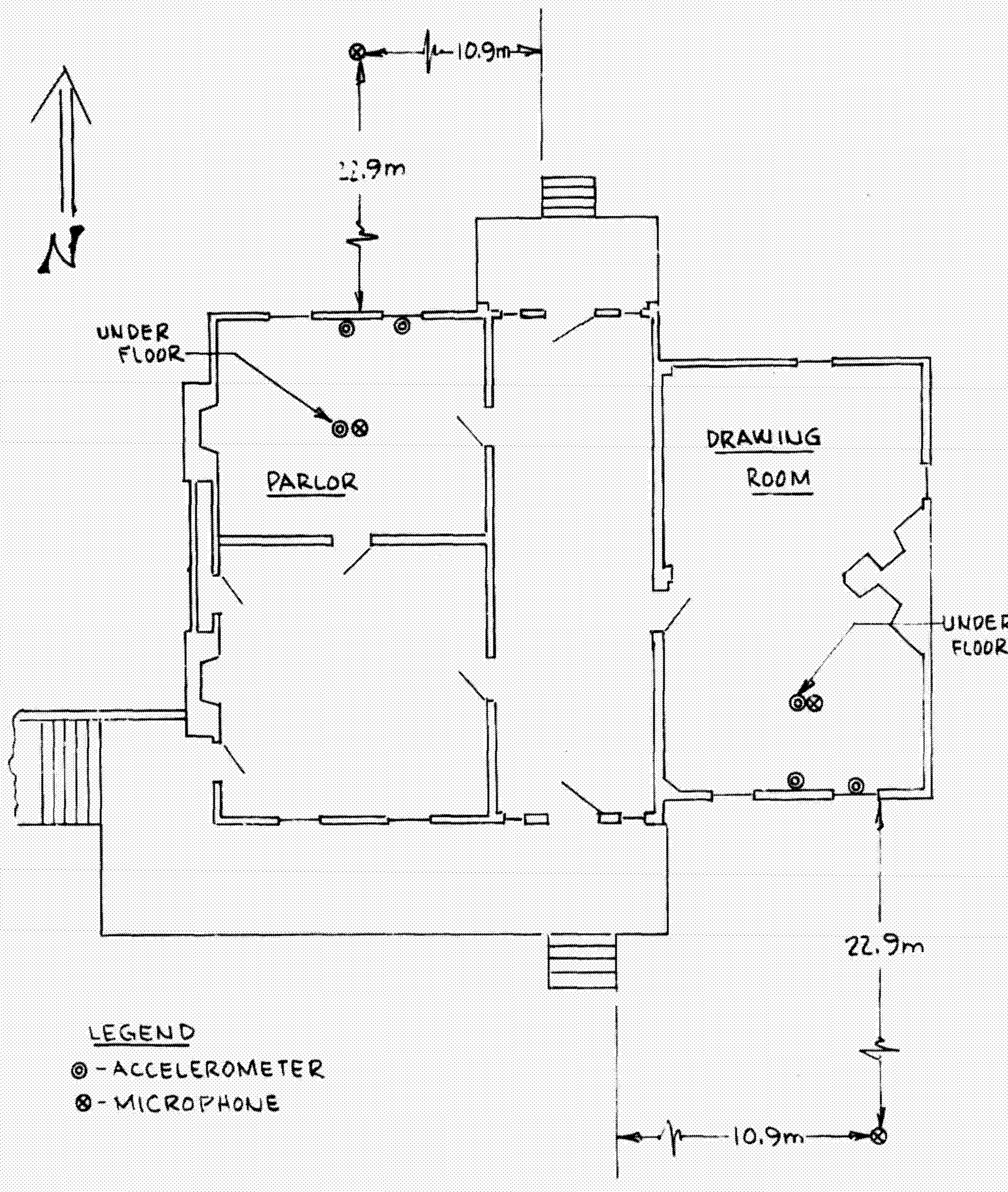

Figure 5.- First floor plan view showing transducer locations.

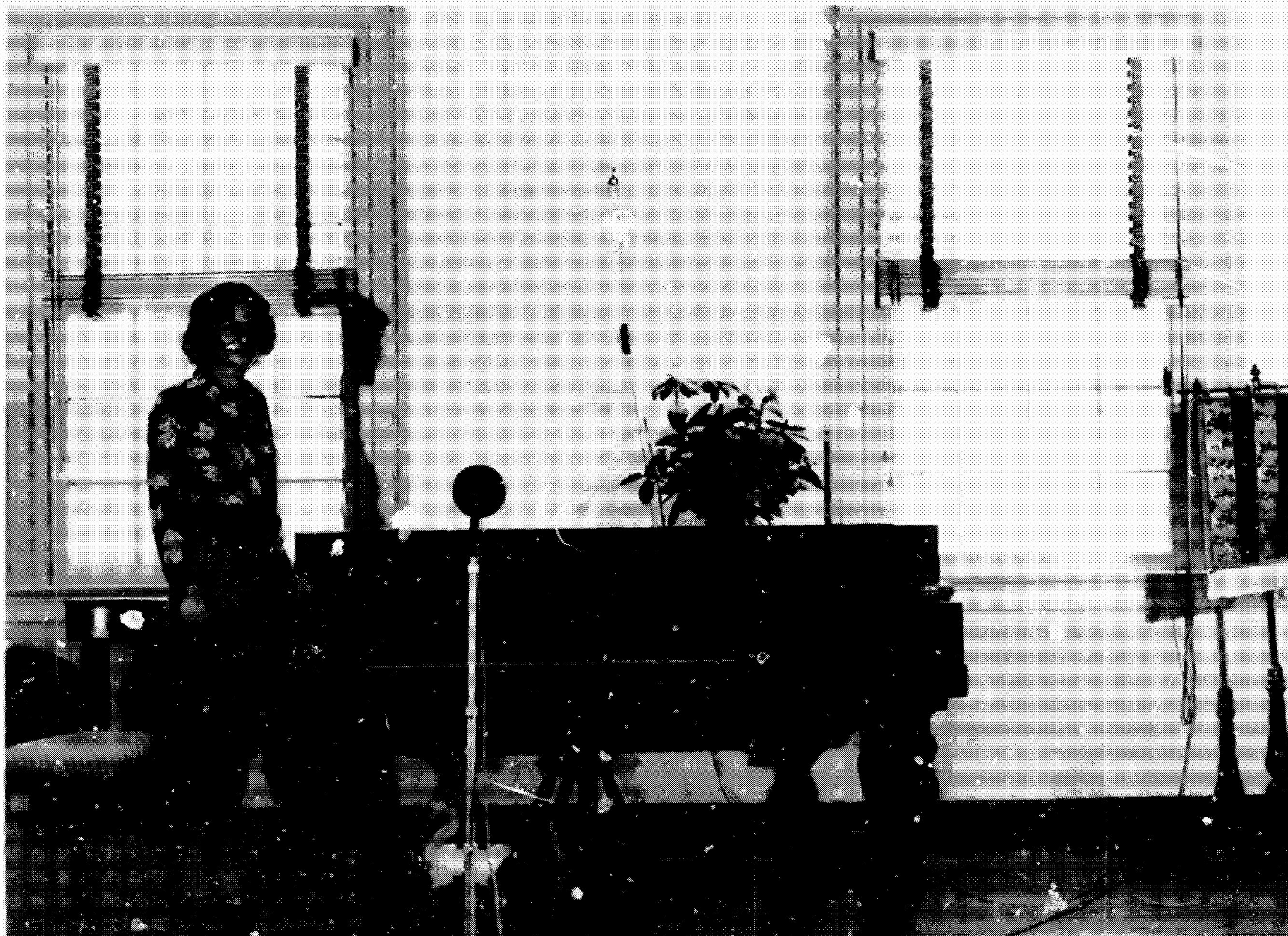

Figure 6.- Location of accelerometer for wall vibration measurements.

Figure 7.- Location of accelerometer for window vibration measurements.

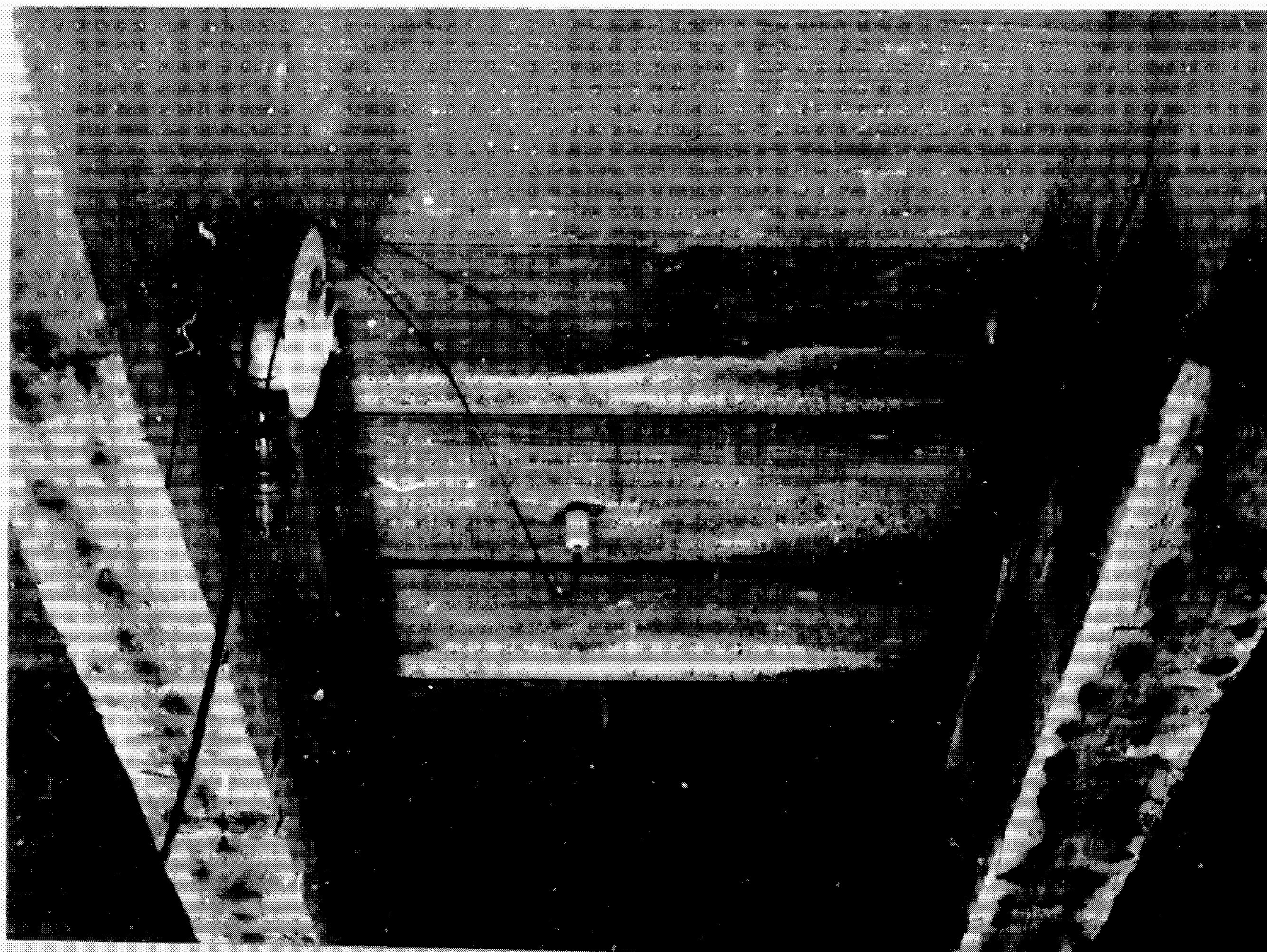

Figure 8.- Location of accelerometer for floor vibration measurements.

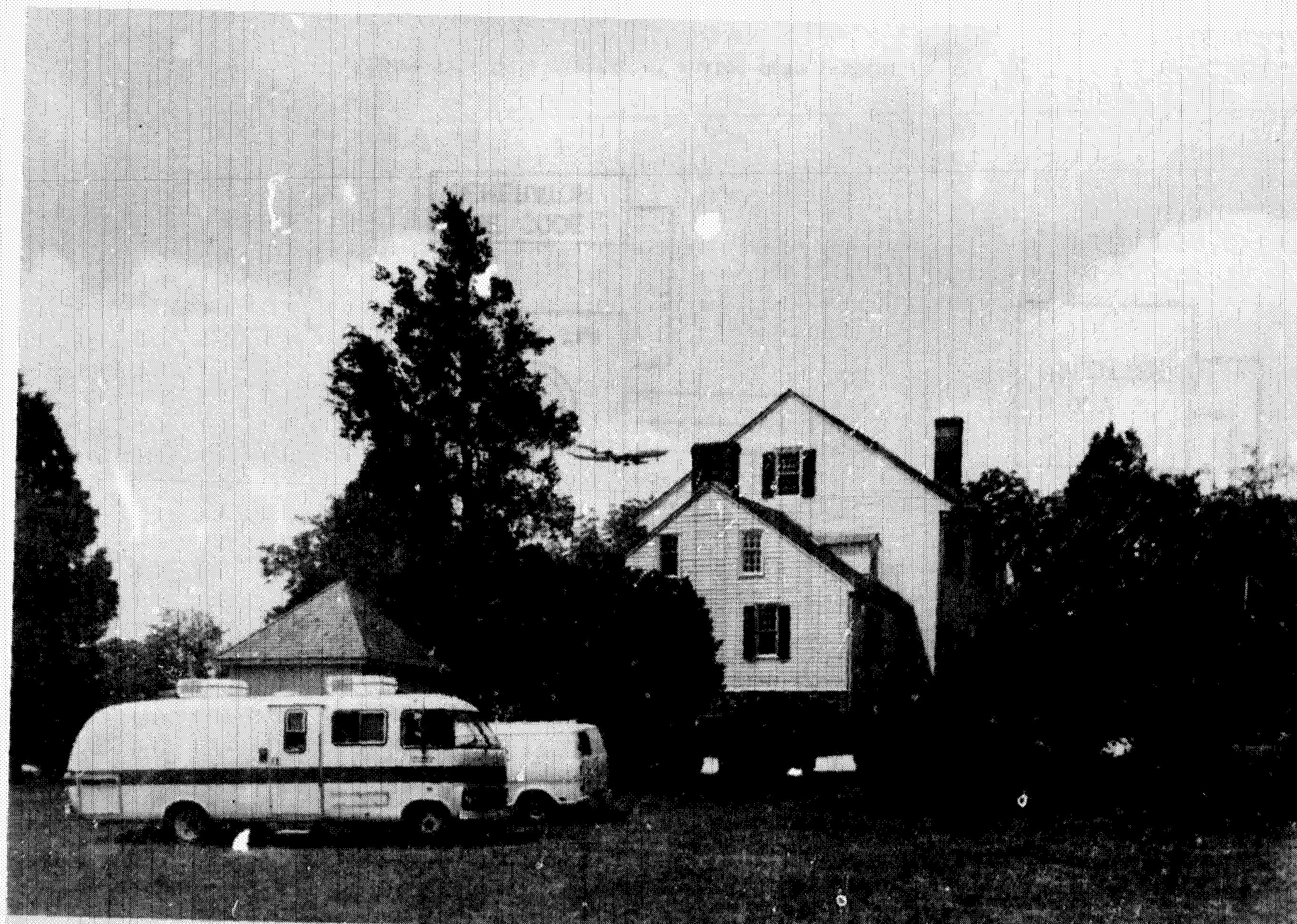

Figure 9.- Mobile data aquisition systems at Sully Plantation.

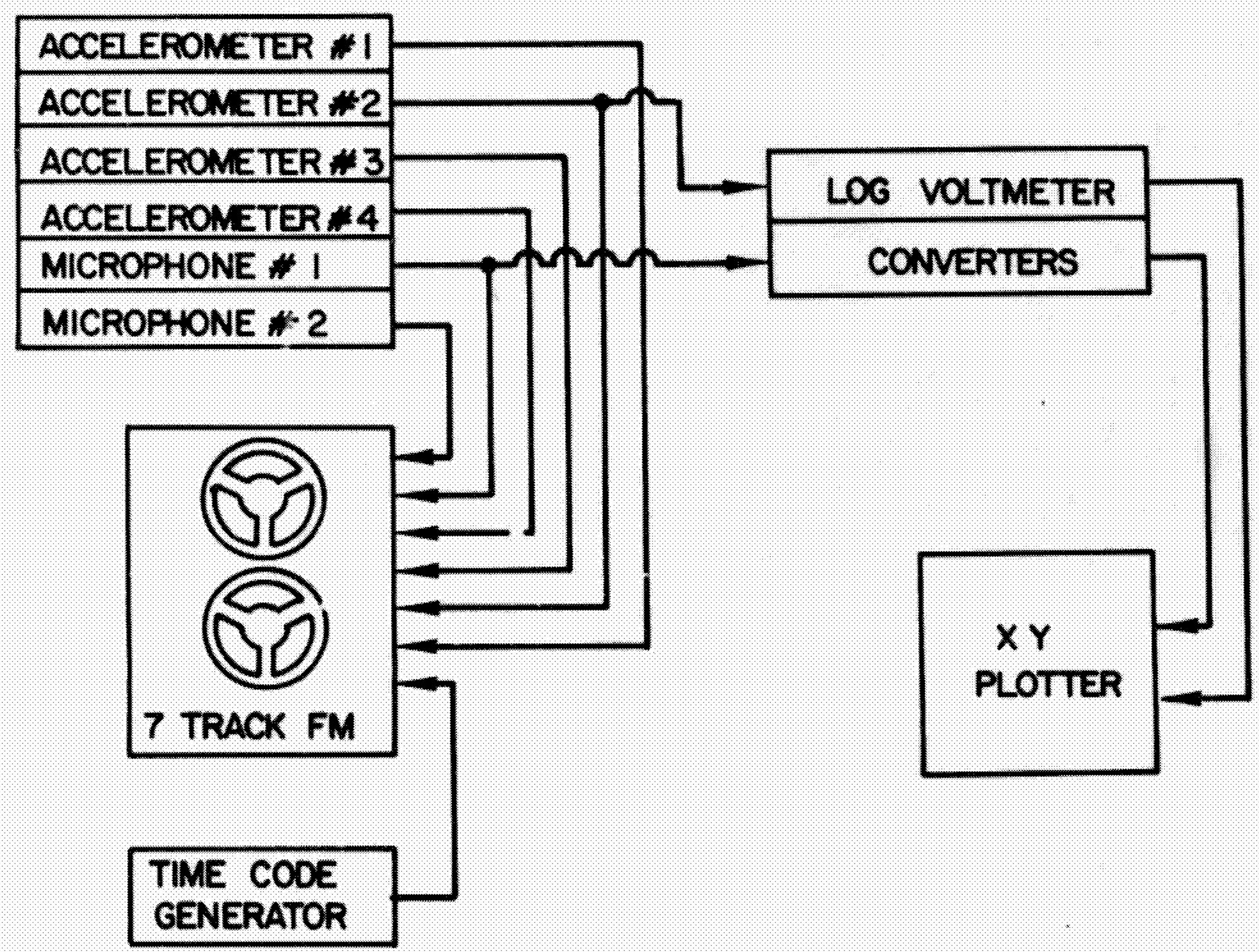

Figure 10.- Data diagram of analog data system.

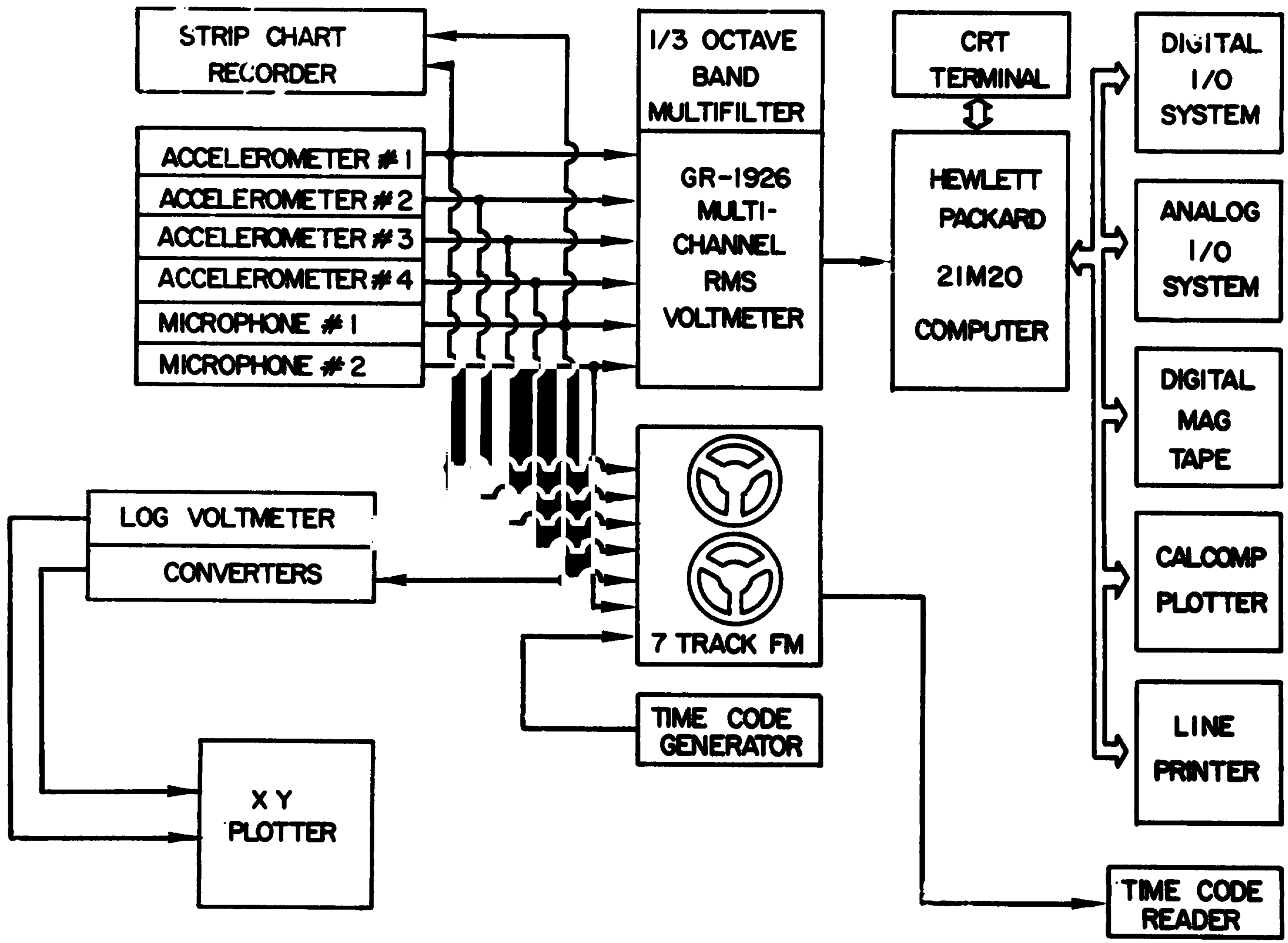

Figure 11.- Block diagrams of mobile data acquisition and processing system.

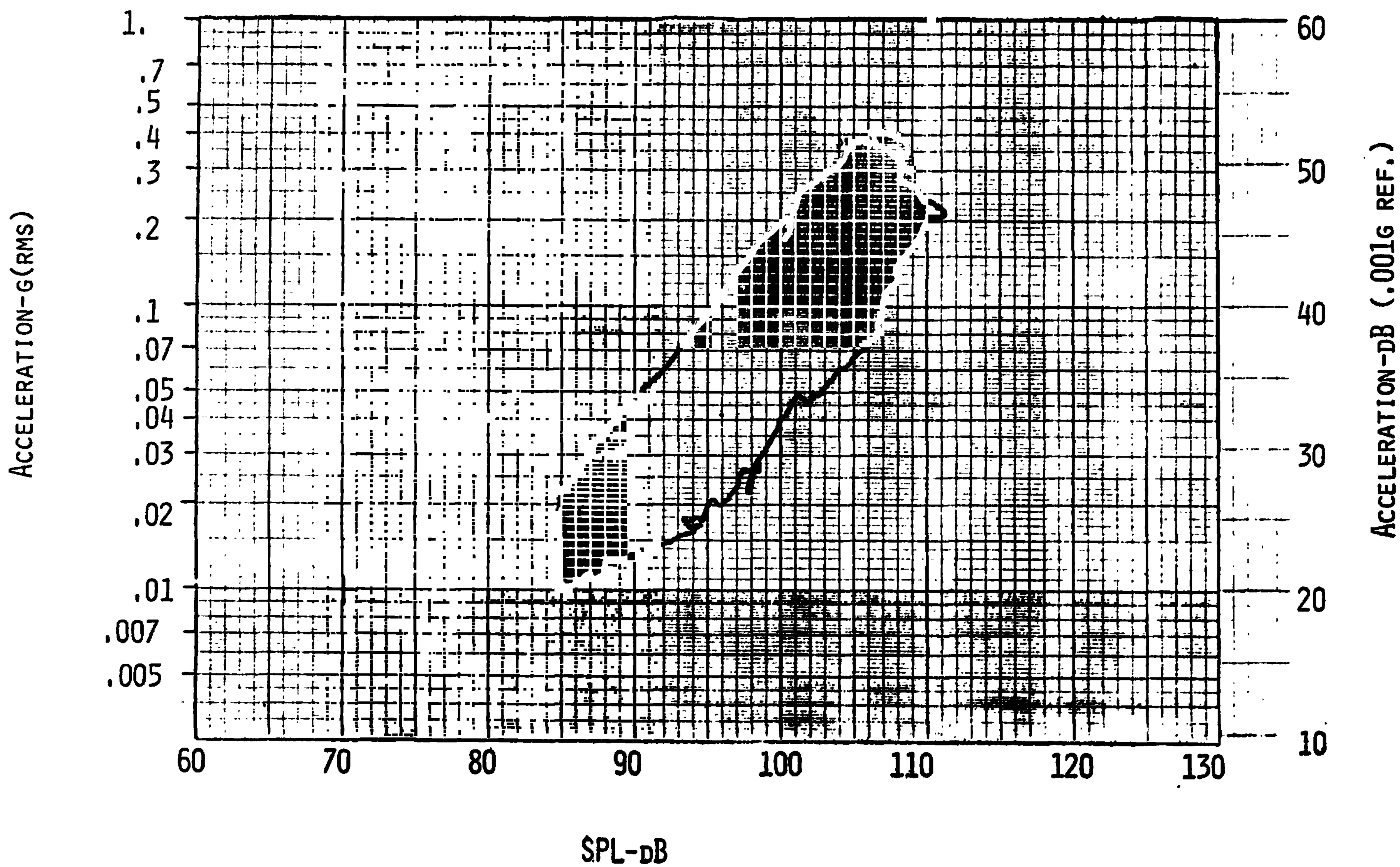

Figure 12.- Analog X-Y plot -AF Concord takeoff.

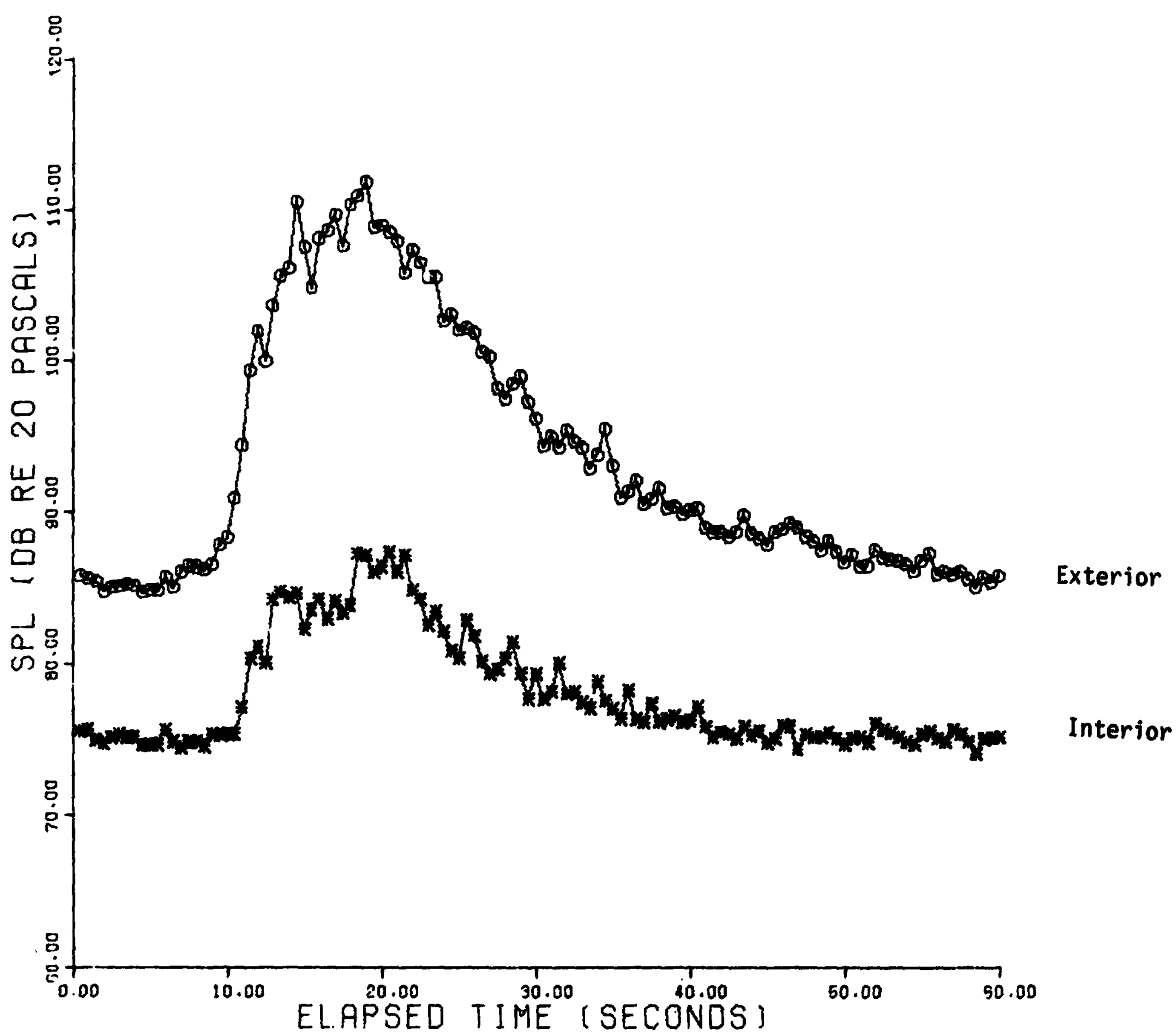

Figure 13.- Time history of sound pressure level -AF Concorde takeoff.

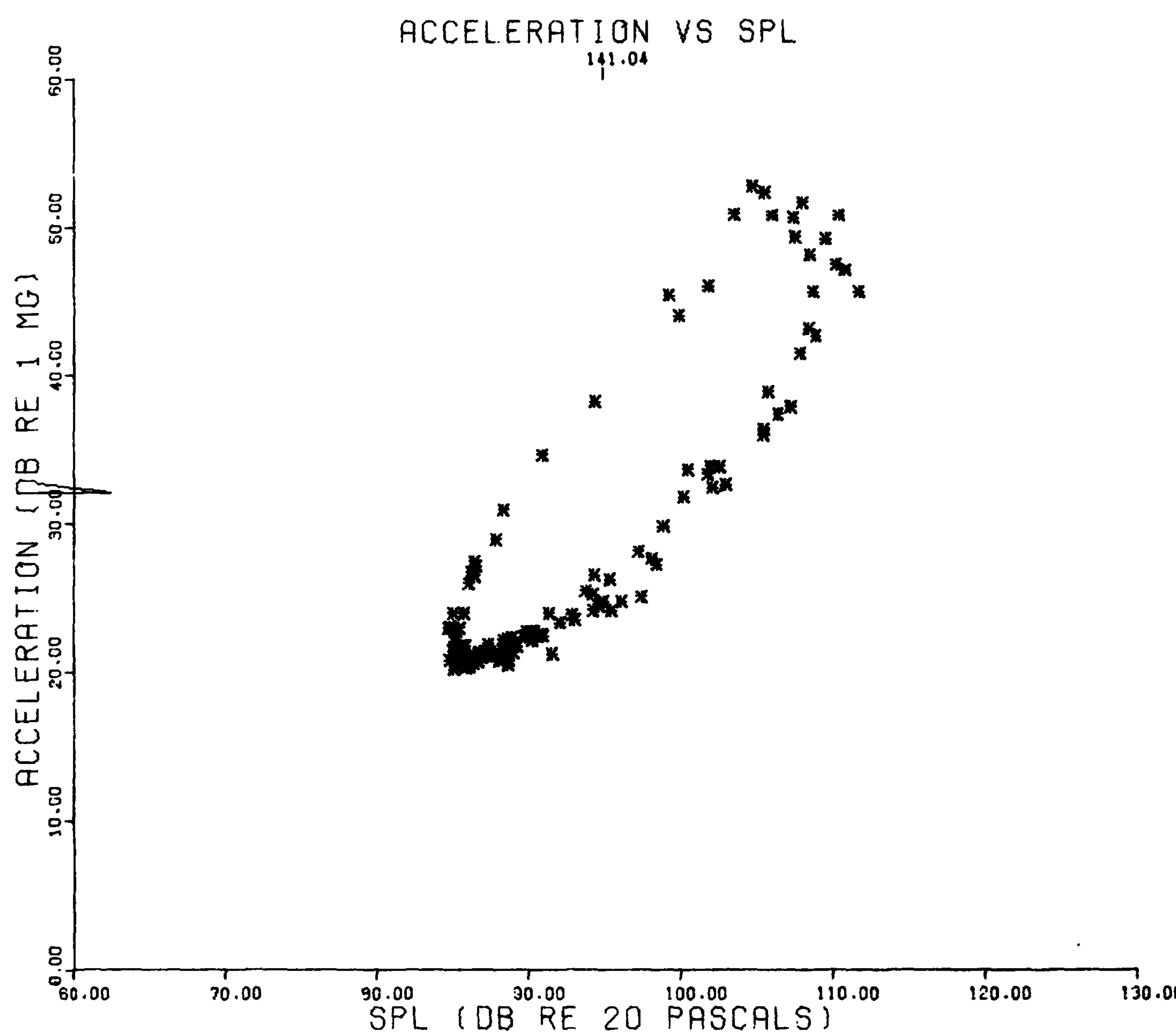

Figure 14.- Digital X-Y plot -AF Concorde takeoff.

Figure 15.- Acoustic calibration

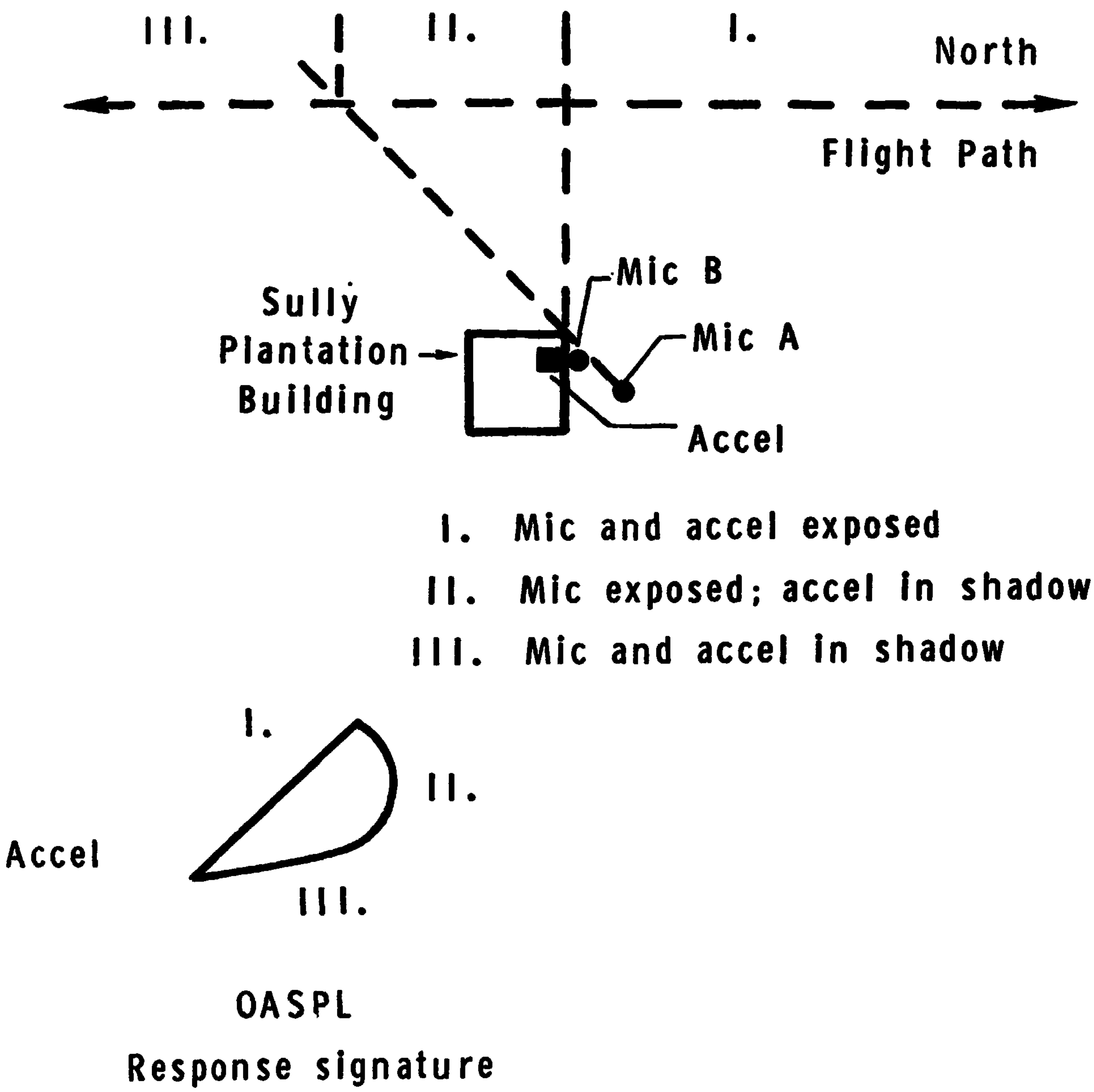

Figure 16.- Propagation path geometry for north wall of aircraft flight path.

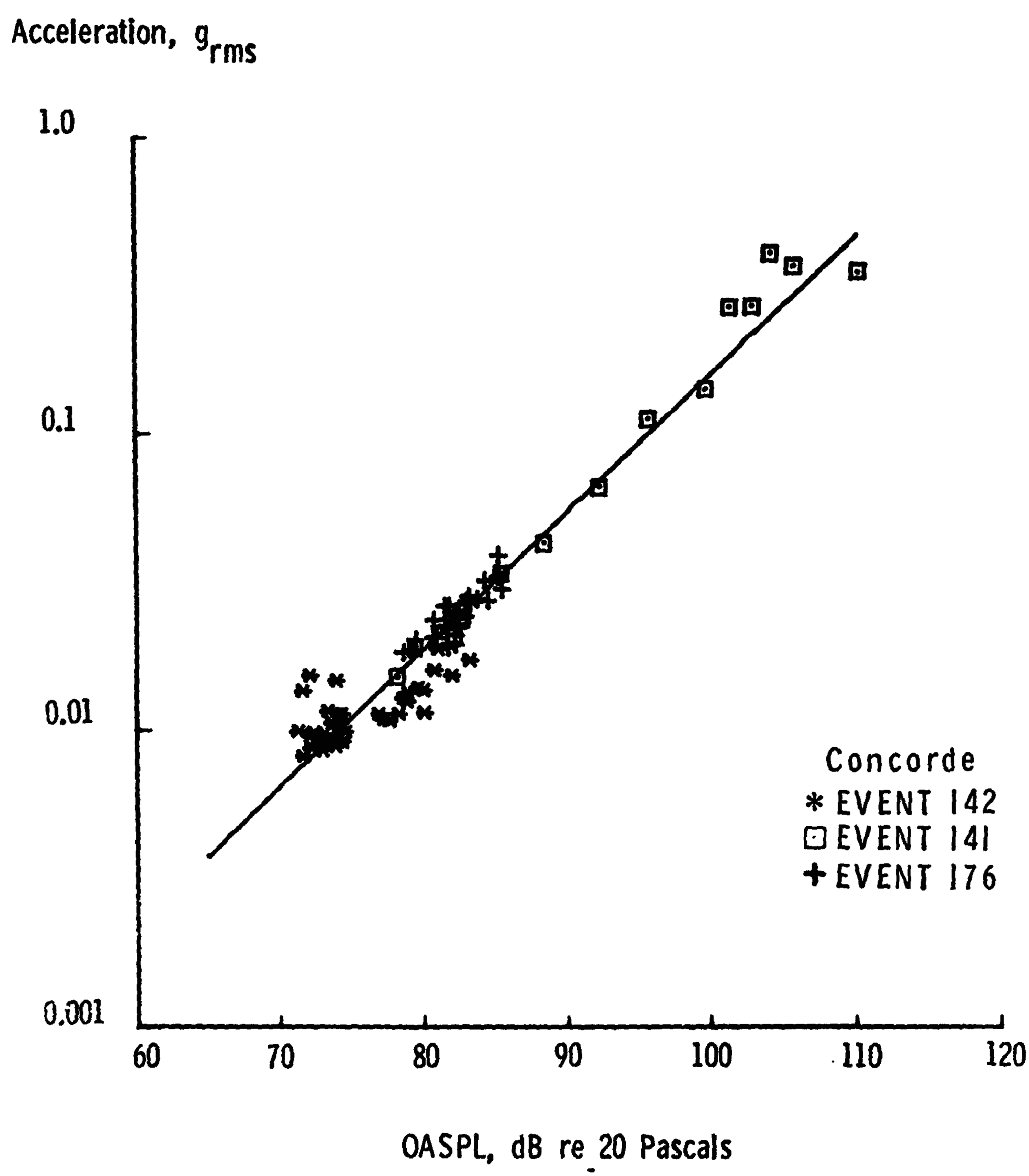

Figure 17.- North window vibration response for Concorde takeoff.

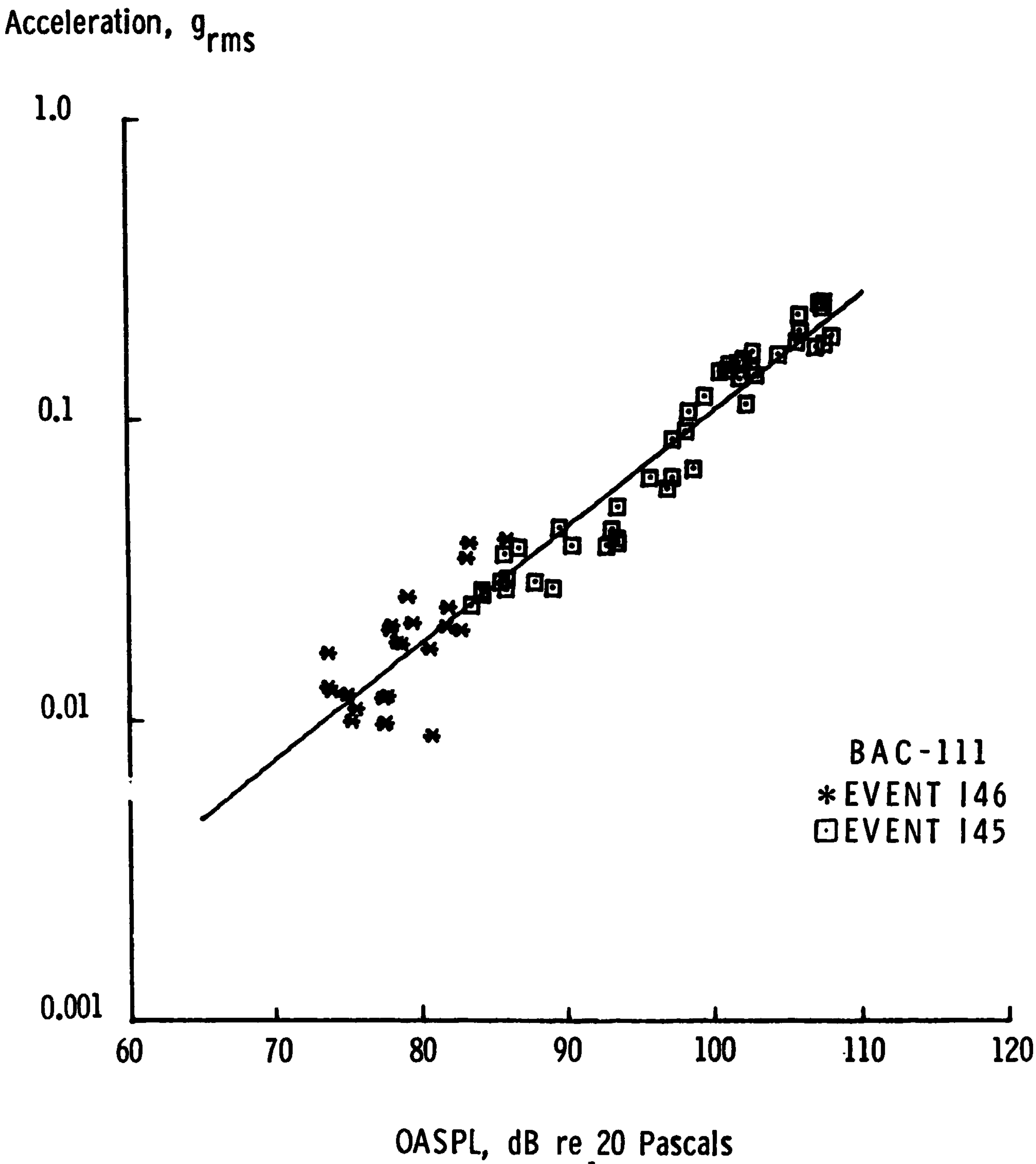

Figure 18.- North window vibration response for BAC-111 takeoff.

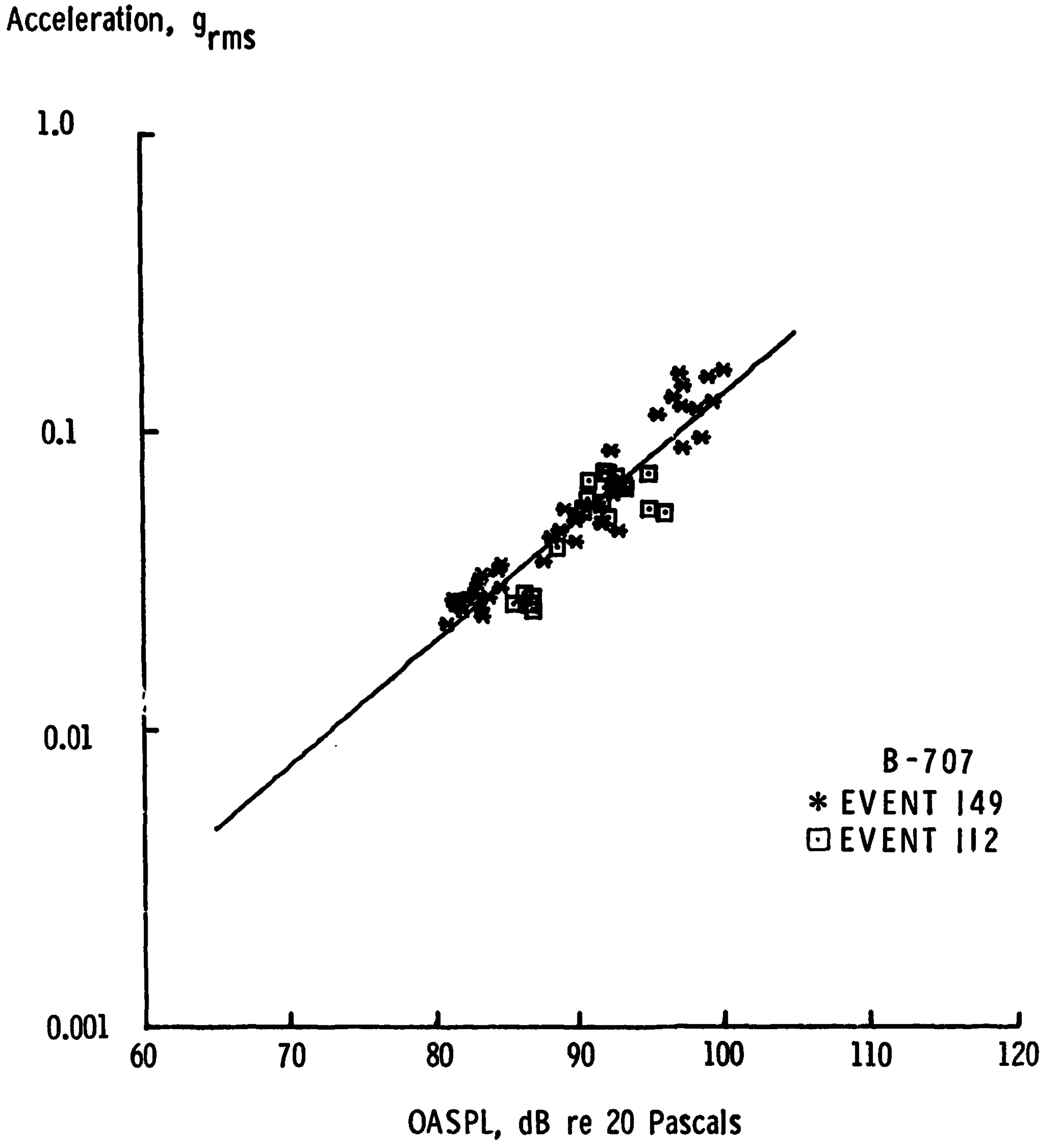

Figure 19.- North window vibration response for B-707 takeoff.

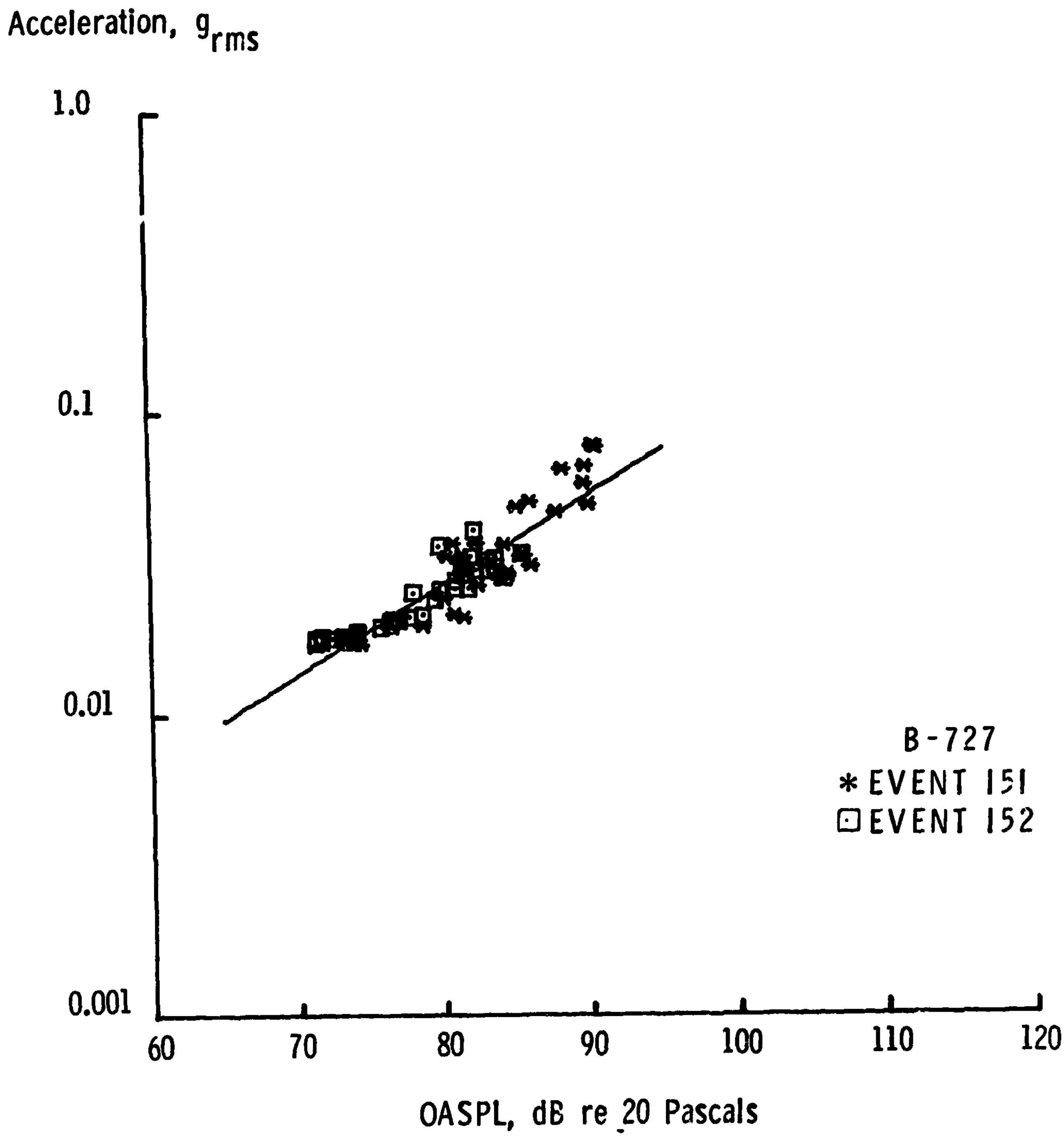

Figure 20.- North window vibration response for B-727 takeoff.

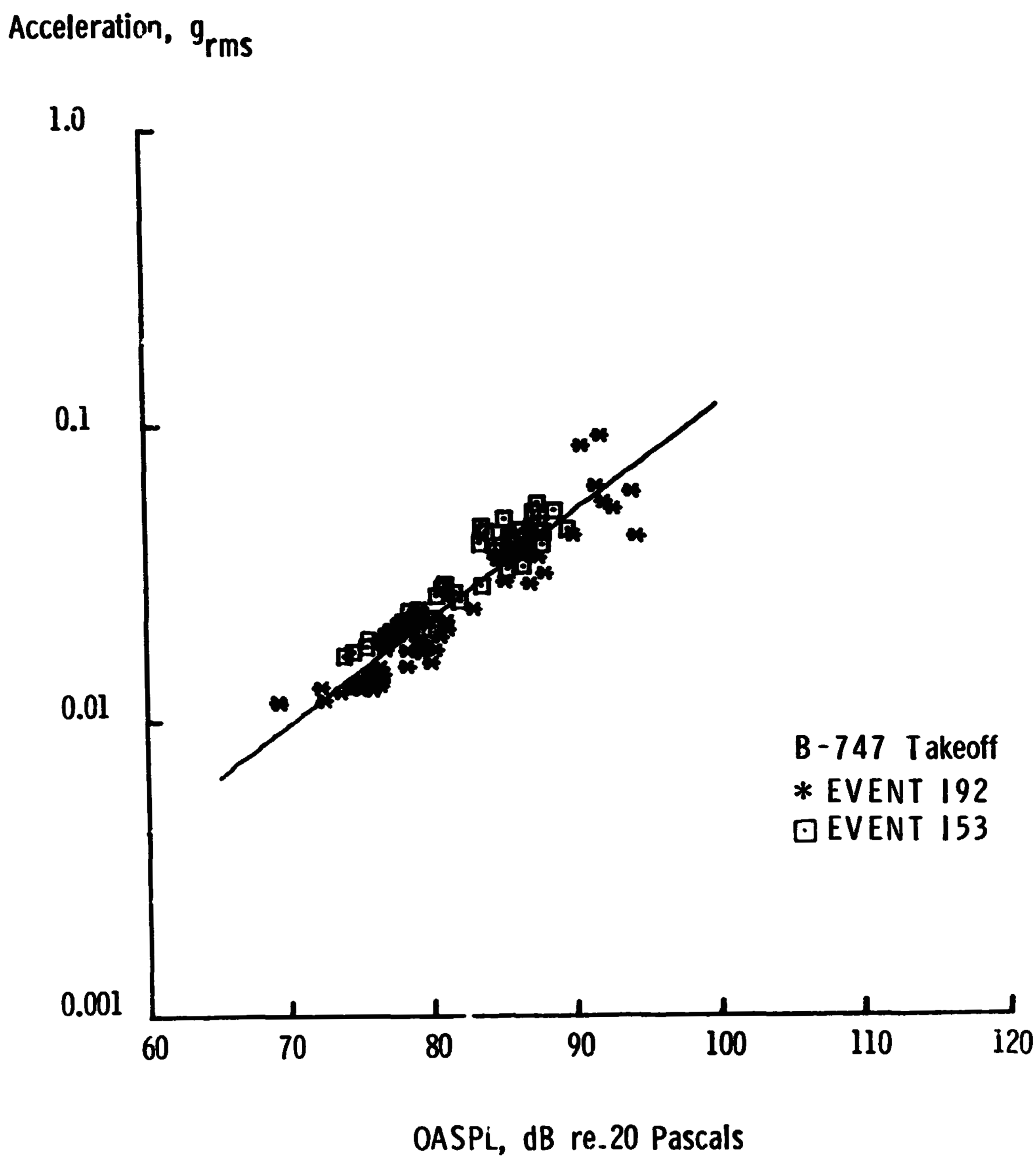

Figure 21.- North window vibration response for B-747 takeoff.

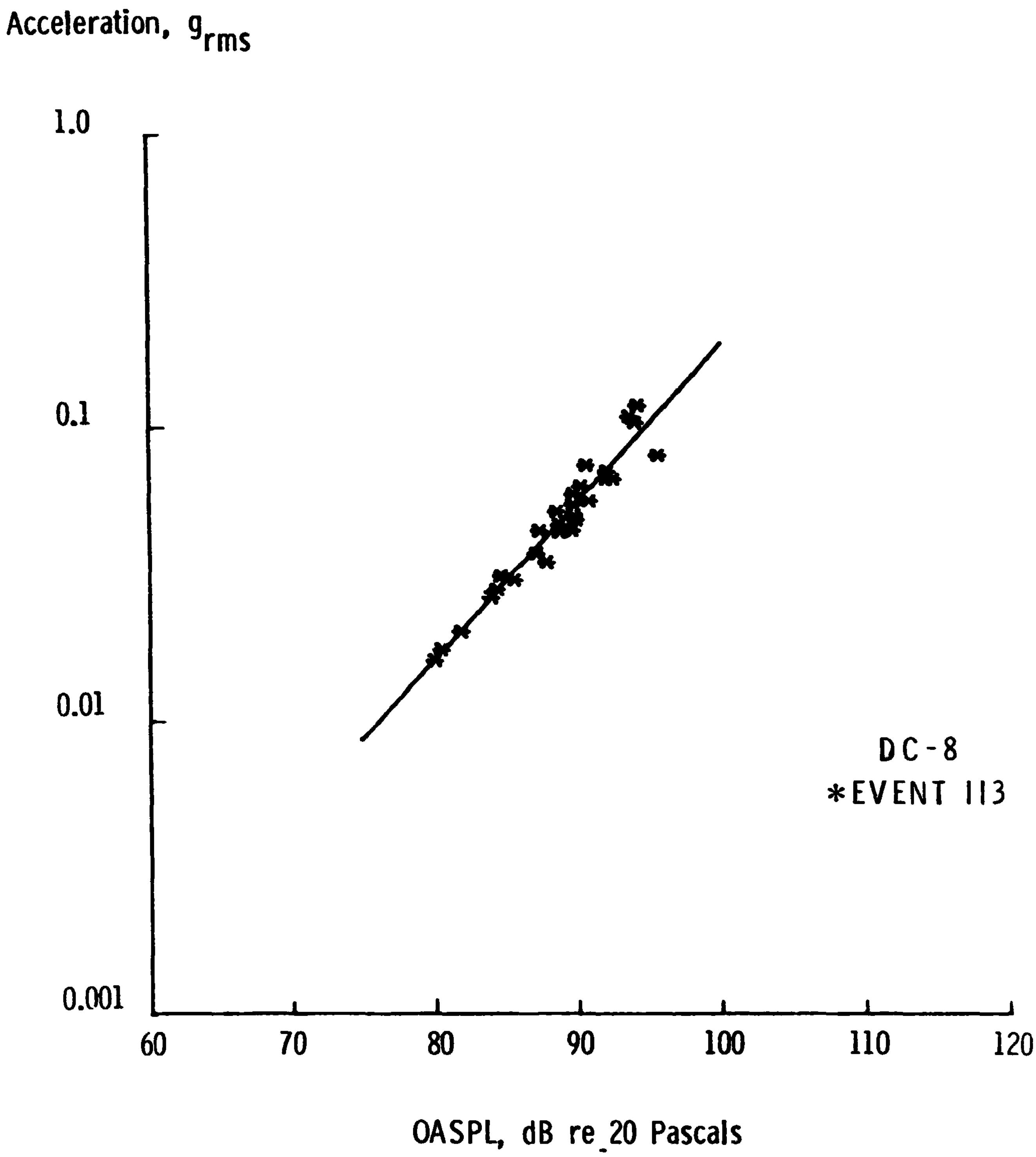

Figure 22.- North window vibration response to DC-8 takeoff.